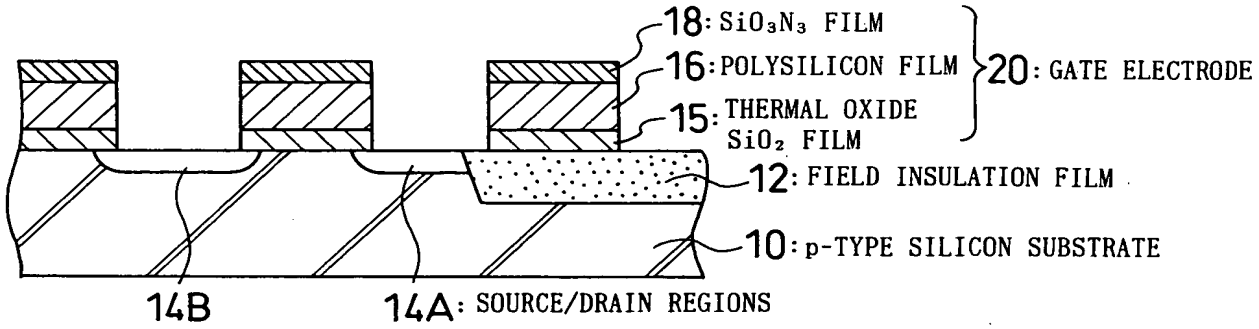
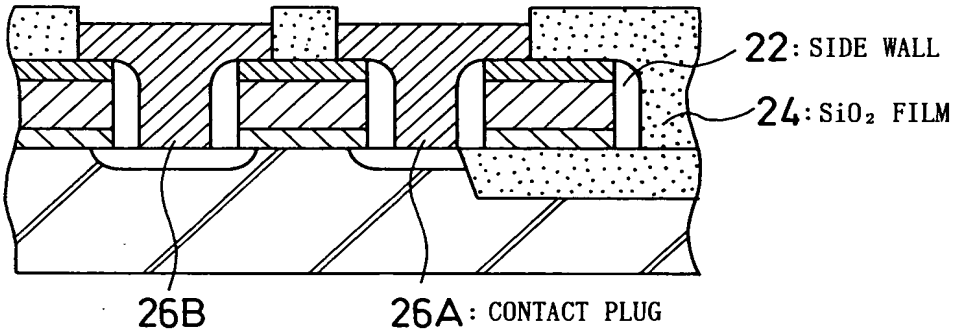
Fig. 1

(a)


18: SiO_3N_3 FILM
16: POLYSILICON FILM
15: THERMAL OXIDE SiO_2 FILM
20: GATE ELECTRODE
12: FIELD INSULATION FILM
10: p-TYPE SILICON SUBSTRATE
14B
14A: SOURCE/DRAIN REGIONS

(b)


22: SIDE WALL
24: SiO_2 FILM
26B
26A: CONTACT PLUG

(c)

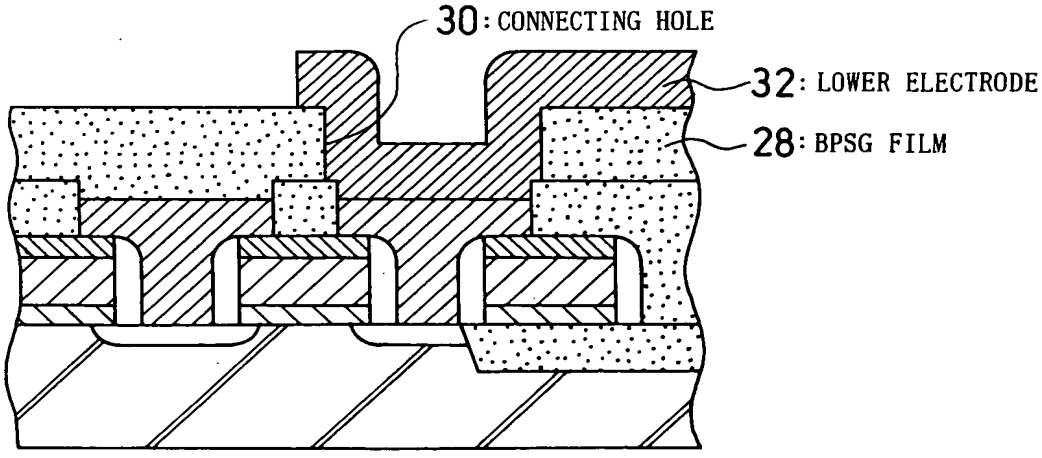
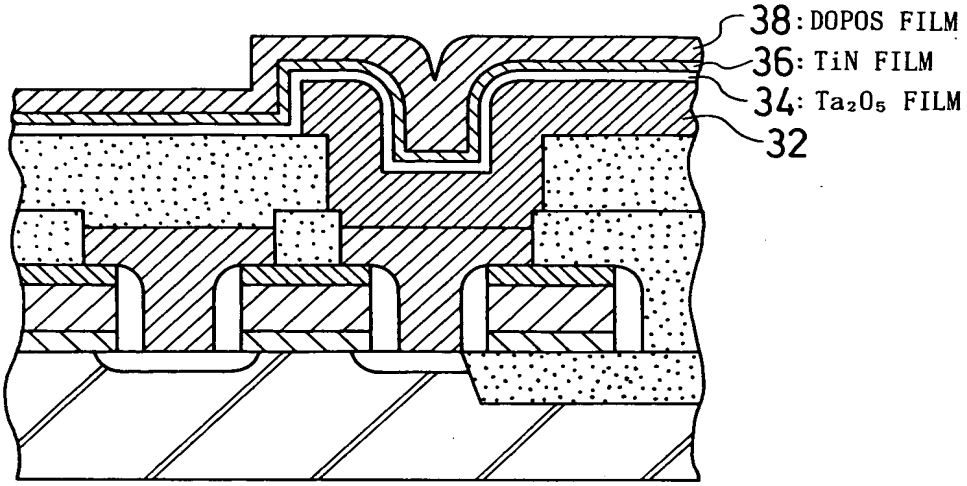

30: CONNECTING HOLE
32: LOWER ELECTRODE
28: BPSG FILM

Fig. 2

(d)


38: DOPOS FILM
36: TiN FILM
34: Ta_2O_5 FILM
32

(e)

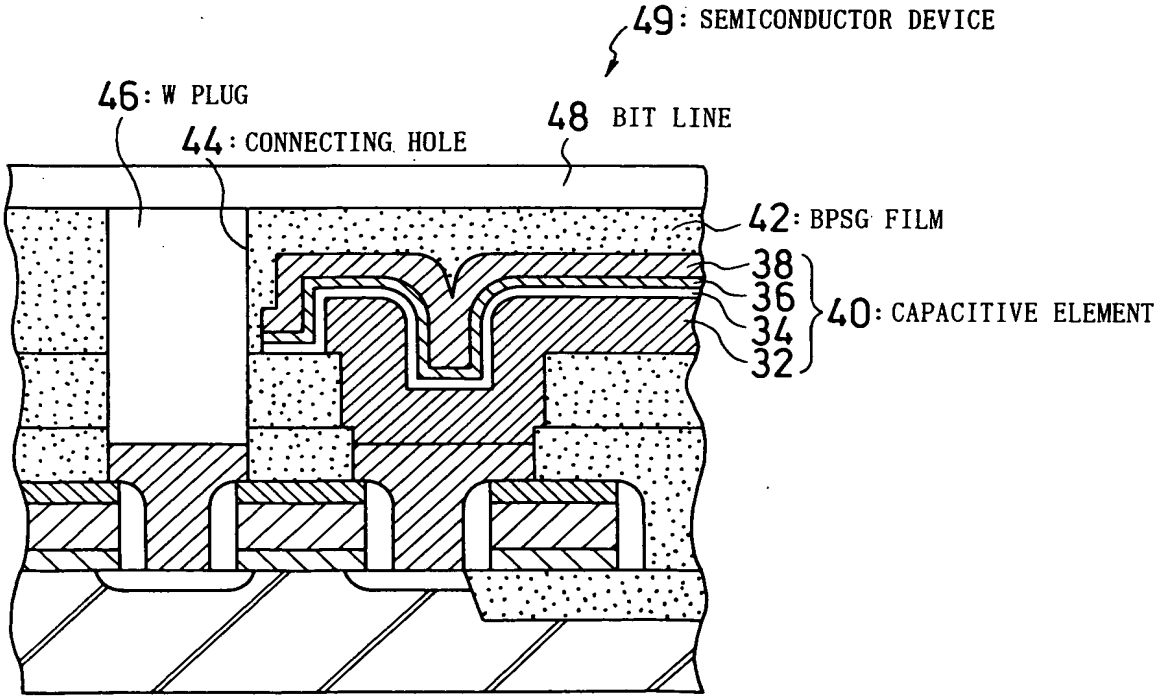

49: SEMICONDUCTOR DEVICE
46: W PLUG
44: CONNECTING HOLE
48 BIT LINE
42: BPSG FILM
38
36
34
32
40: CAPACITIVE ELEMENT

Fig. 3

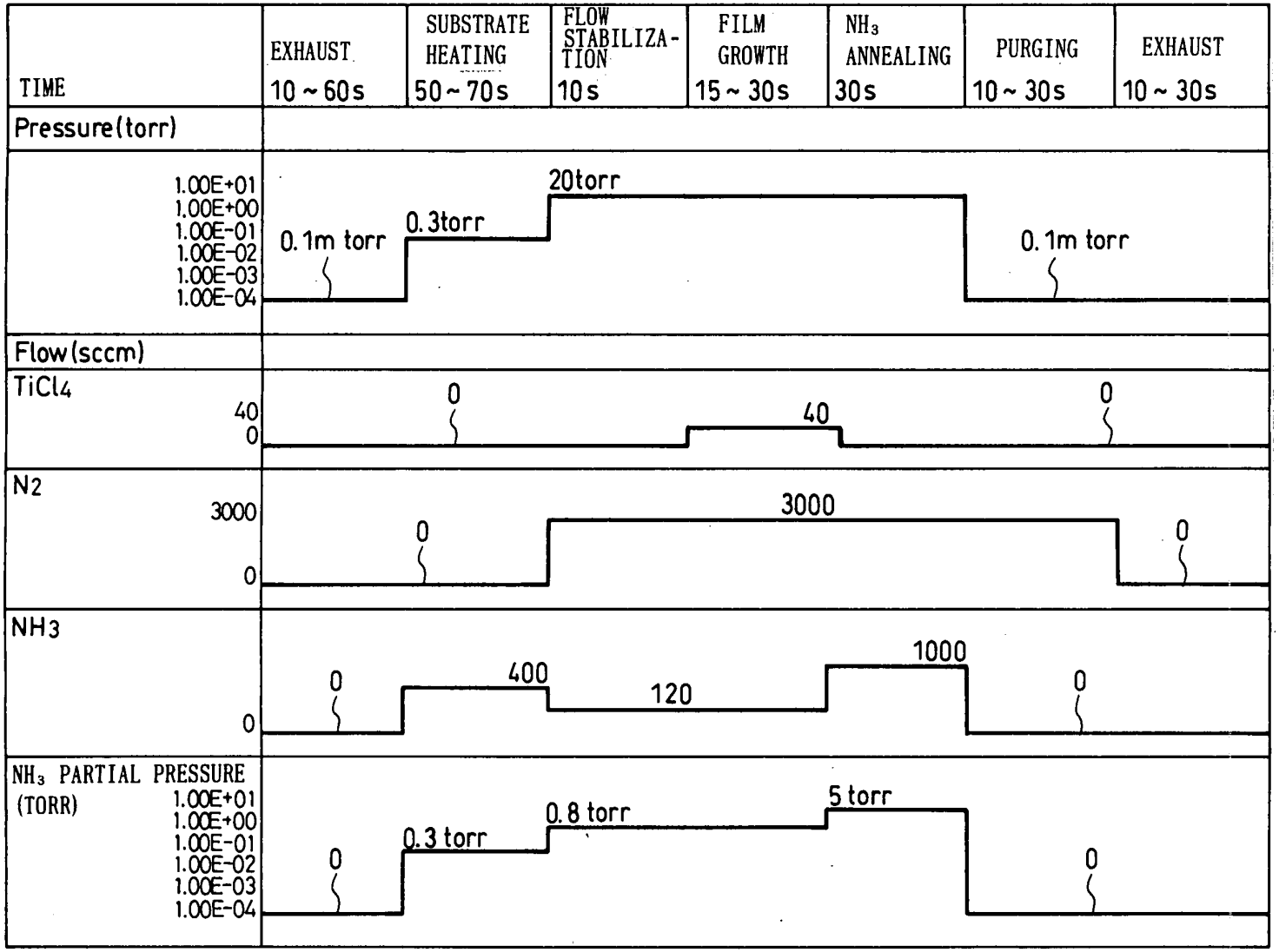
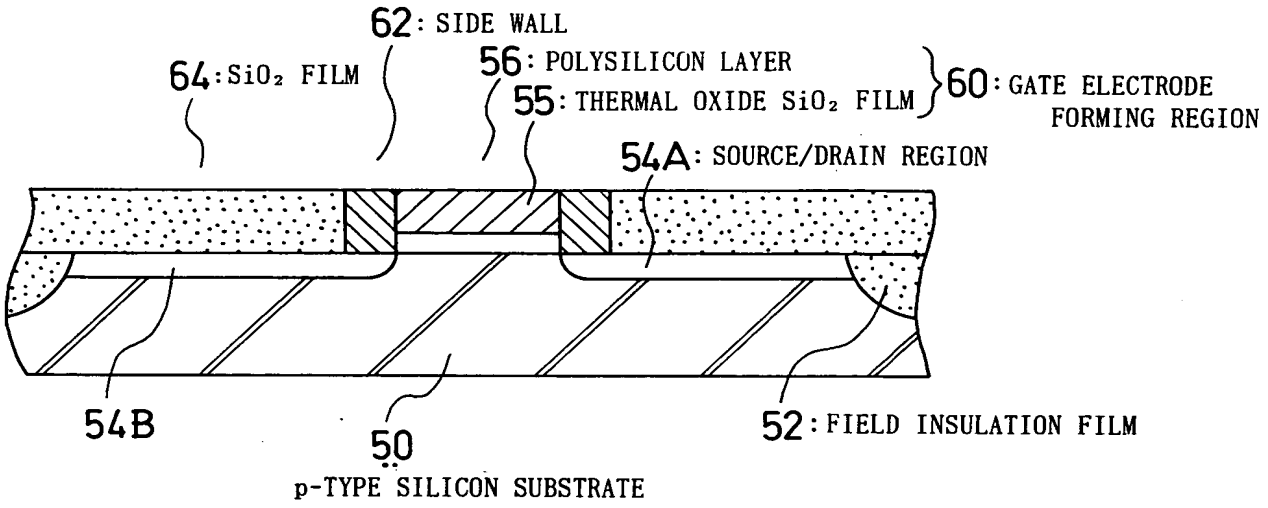


Fig. 4

(a)


62: SIDE WALL
64: SiO2 FILM
56: POLYSILICON LAYER
55: THERMAL OXIDE SiO2 FILM
60: GATE ELECTRODE FORMING REGION
54A: SOURCE/DRAIN REGION
54B
50
p-TYPE SILICON SUBSTRATE
52: FIELD INSULATION FILM

(b)

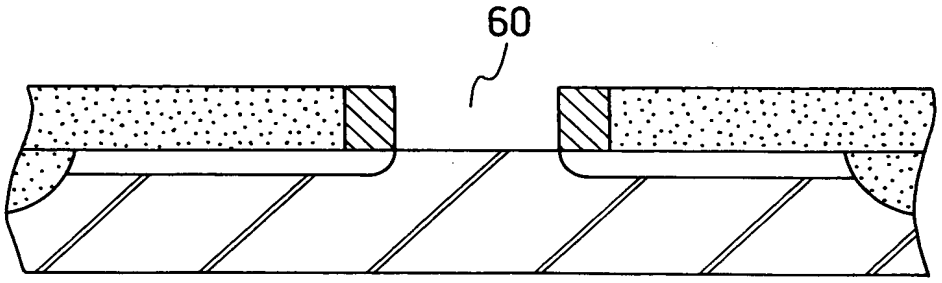
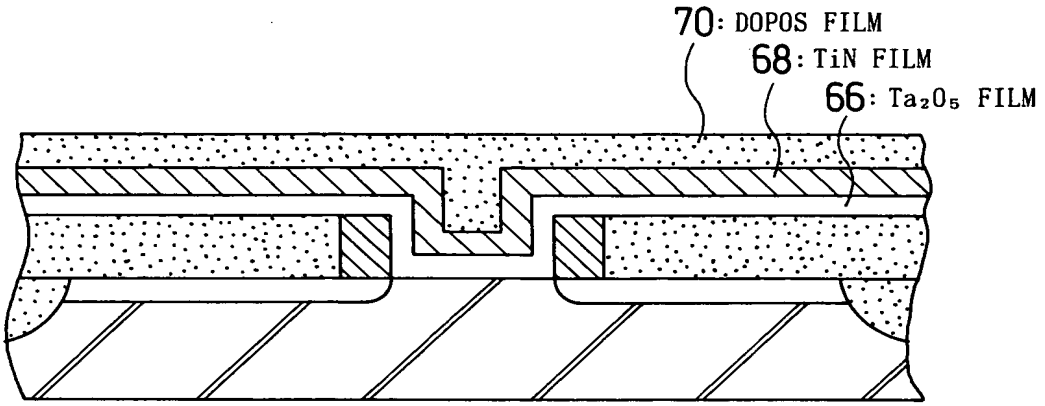

60

Fig. 5

(c)


70: DOPOS FILM
68: TiN FILM
66: Ta_2O_5 FILM

(d)

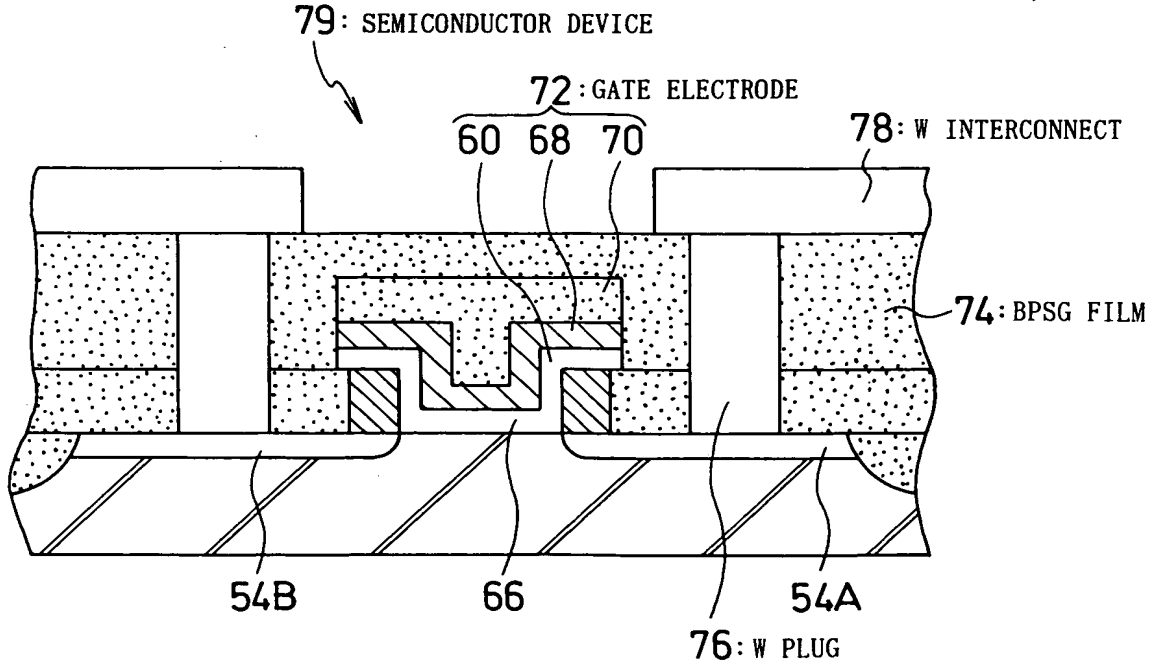

79: SEMICONDUCTOR DEVICE
72: GATE ELECTRODE
60 68 70
78: W INTERCONNECT
74: BPSG FILM
54B
66
54A
76: W PLUG

Fig. 6

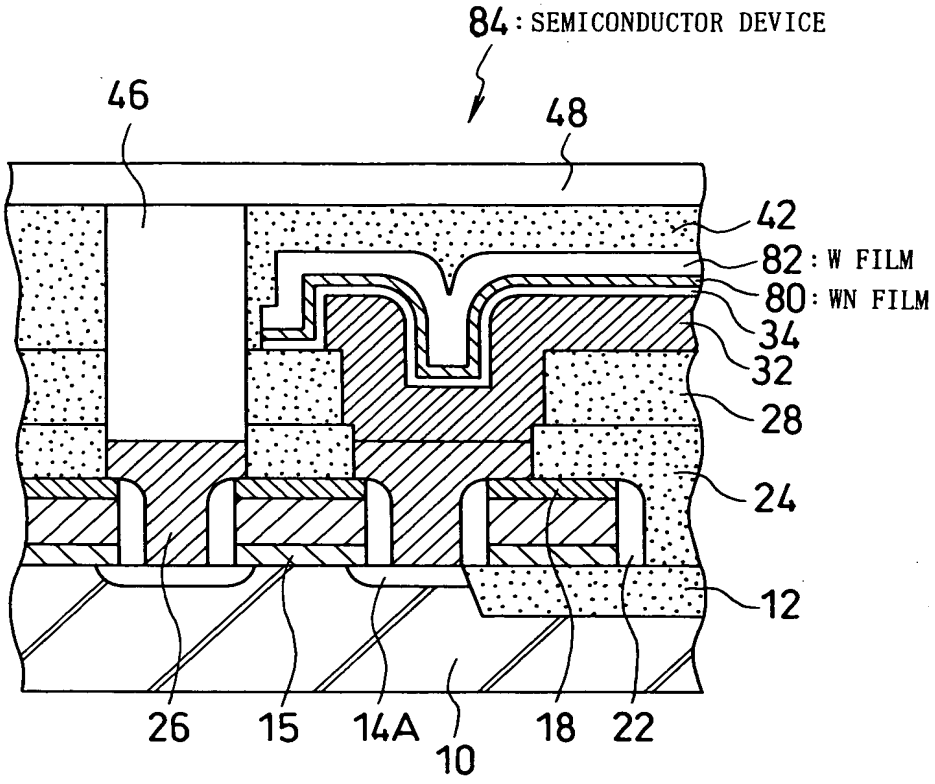

84 : SEMICONDUCTOR DEVICE
46
48
42
82 : W FILM
80 : WN FILM
34
32
28
24
12
26
15
14A
10
18
22

Fig. 7

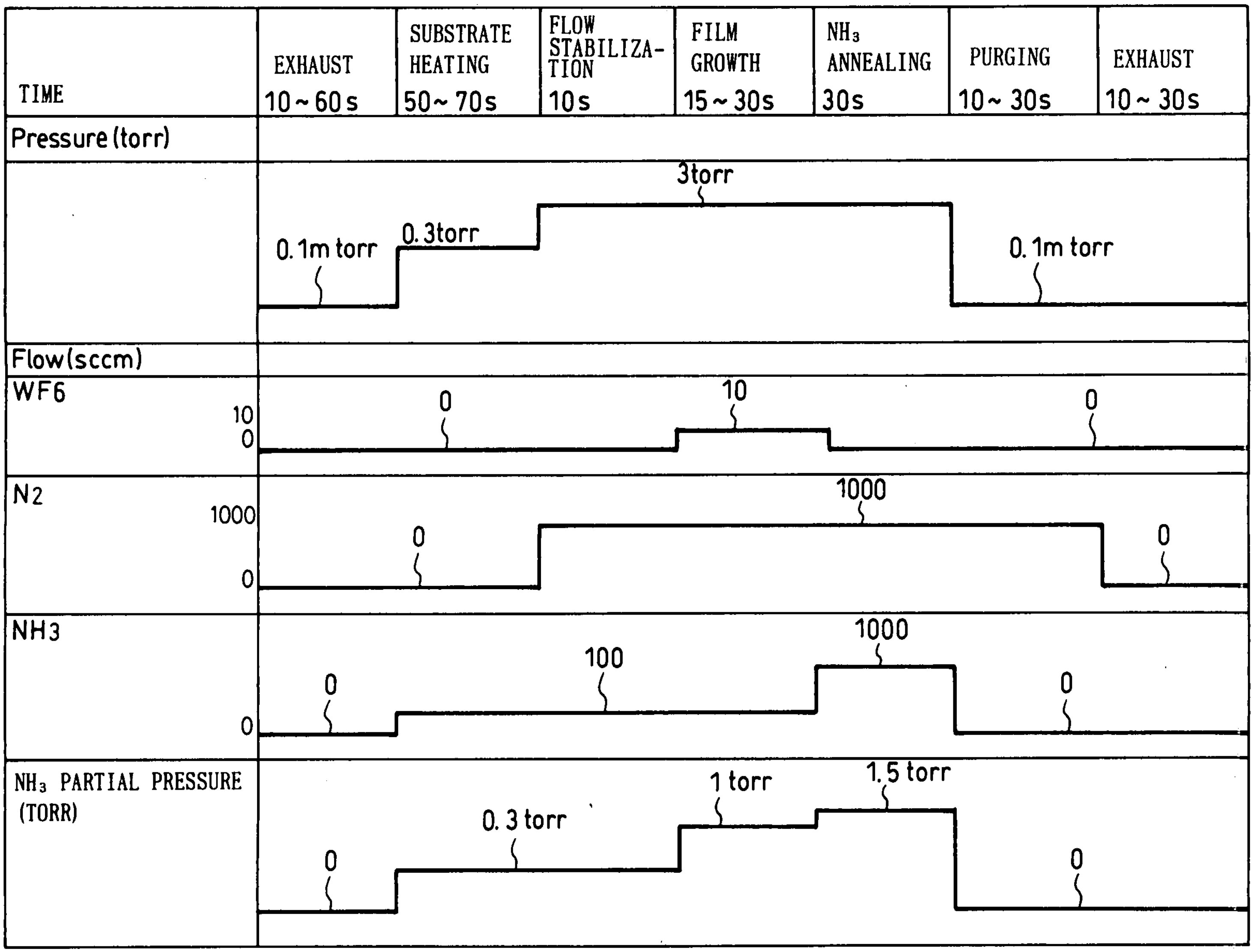

TIME
EXHAUST 10 ~ 60 s
SUBSTRATE HEATING 50 ~ 70 s
FLOW STABILIZA-TION 10 s
FILM GROWTH 15 ~ 30 s
NH3 ANNEALING 30 s
PURGING 10 ~ 30 s
EXHAUST 10 ~ 30 s
Pressure (torr)
0.1m torr
0.3torr
3torr
0.1m torr
Flow (sccm)
WF6
10
0
0
10
0
N2
1000
0
0
1000
0
NH3
0
0
100
1000
0
NH3 PARTIAL PRESSURE (TORR)
0
0.3 torr
1 torr
1.5 torr
0

Fig. 8

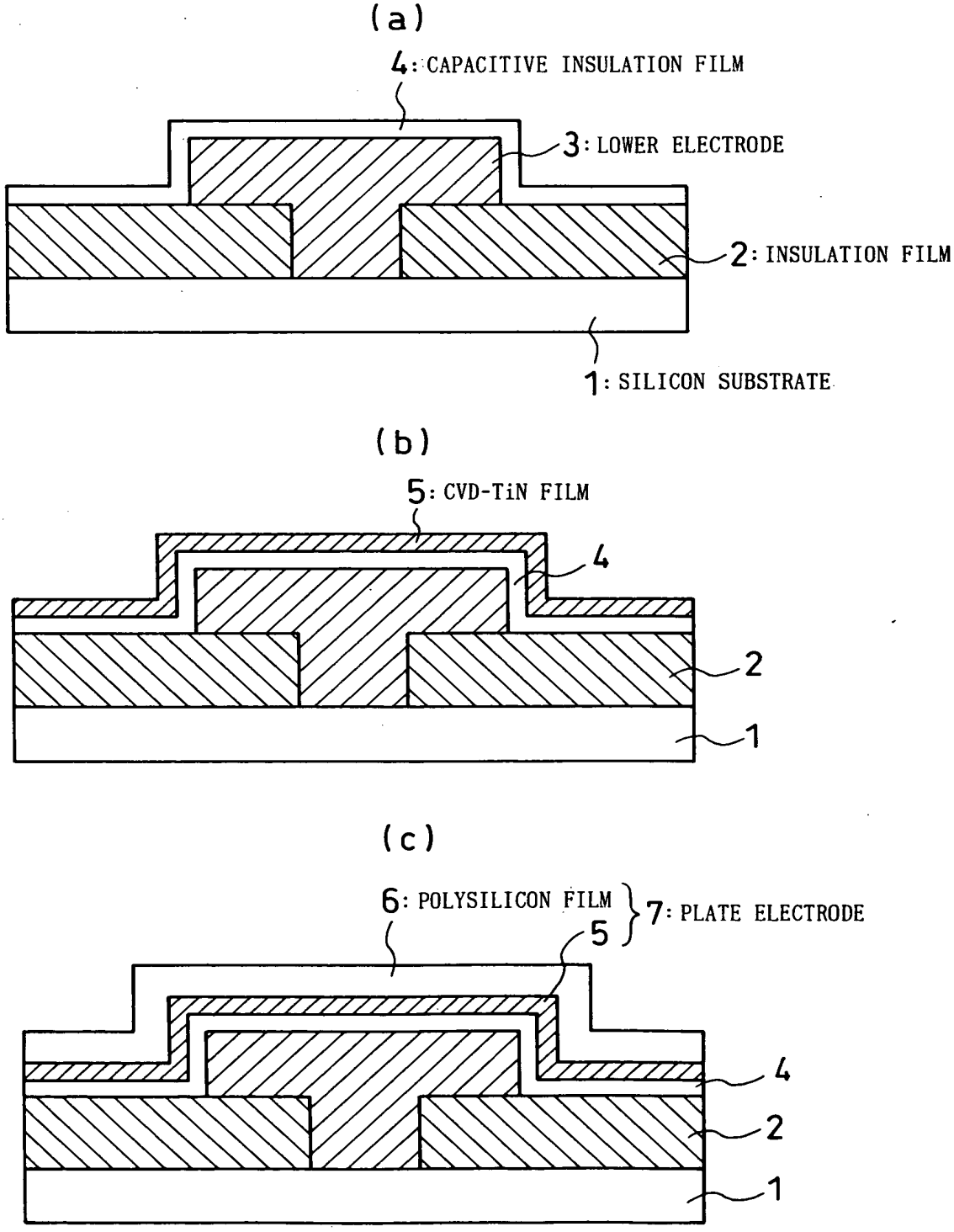

(a)
4: CAPACITIVE INSULATION FILM
3: LOWER ELECTRODE
2: INSULATION FILM
1: SILICON SUBSTRATE
(b)
5: CVD-TiN FILM
4
2
1
(c)
6: POLYSILICON FILM
7: PLATE ELECTRODE
5
4
2
1

Fig. 9

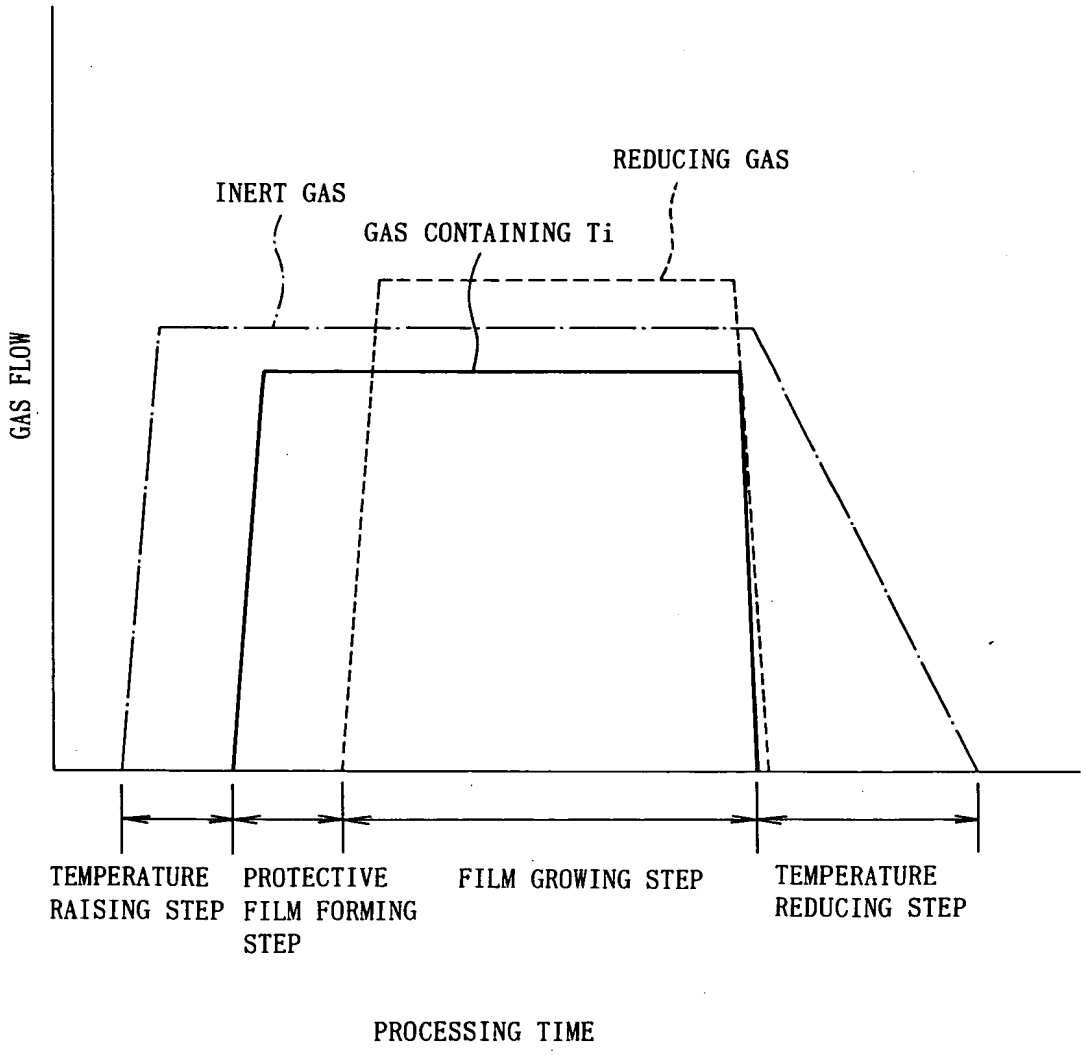

REDUCING GAS
INERT GAS
GAS CONTAINING Ti
GAS FLOW
TEMPERATURE RAISING STEP
PROTECTIVE FILM FORMING STEP
FILM GROWING STEP
TEMPERATURE REDUCING STEP
PROCESSING TIME

Fig. 10

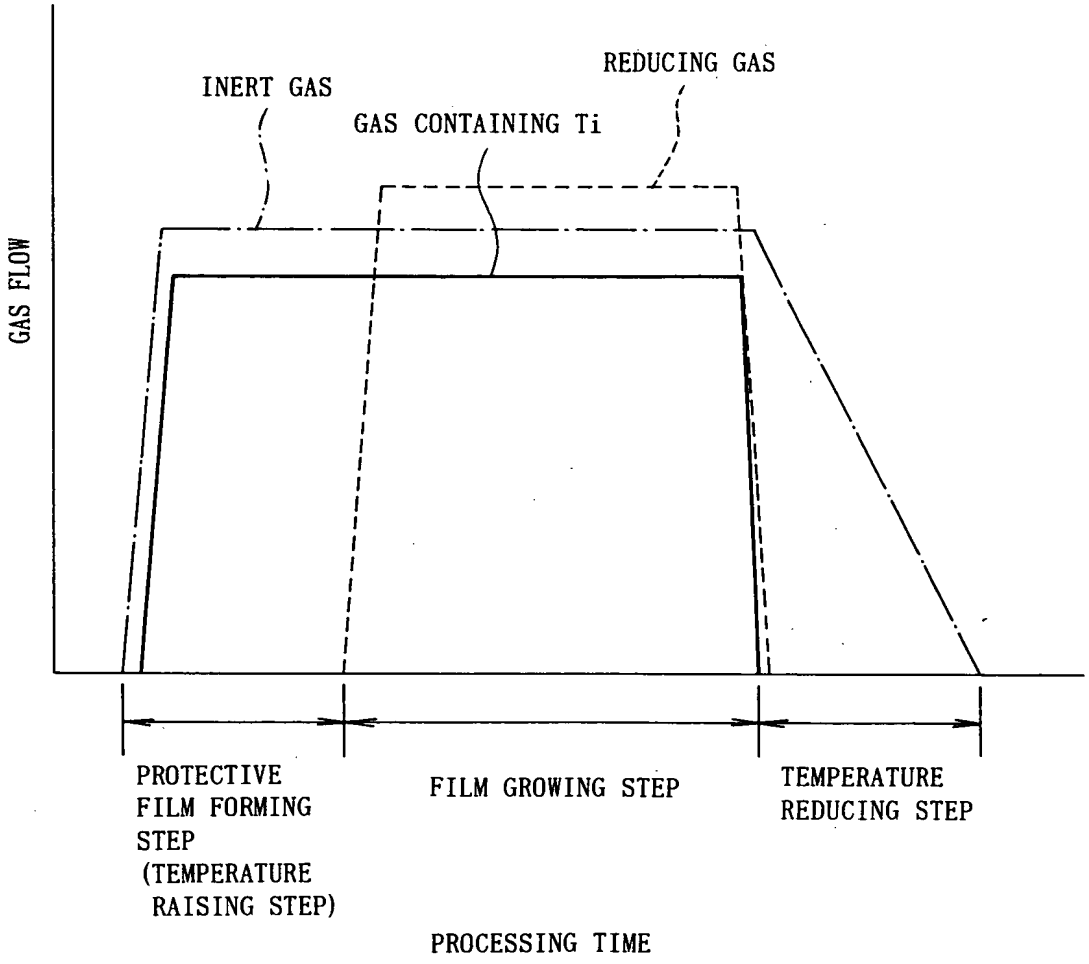

INERT GAS
REDUCING GAS
GAS CONTAINING Ti
GAS FLOW
PROTECTIVE FILM FORMING STEP (TEMPERATURE RAISING STEP)
FILM GROWING STEP
TEMPERATURE REDUCING STEP
PROCESSING TIME

Fig. 11

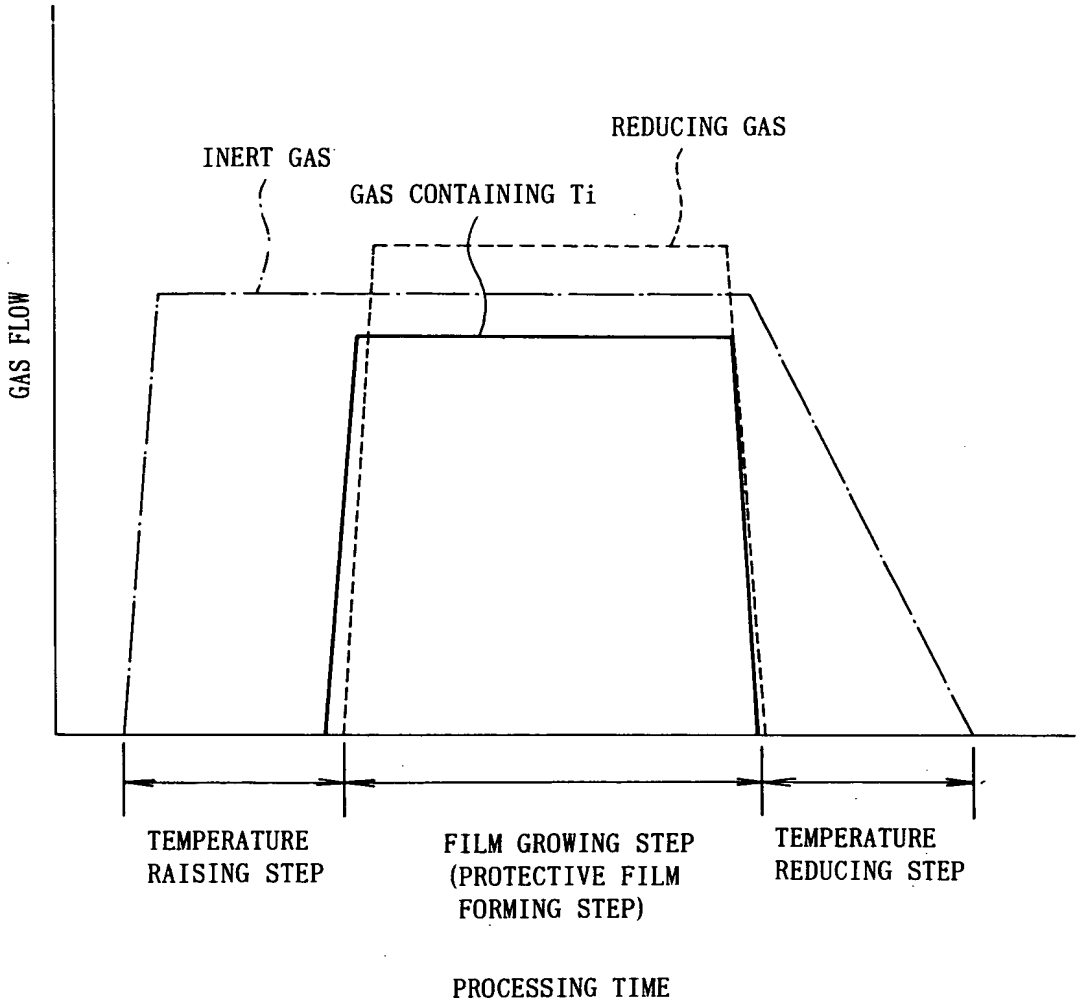

REDUCING GAS
INERT GAS
GAS CONTAINING Ti
GAS FLOW
TEMPERATURE RAISING STEP
FILM GROWING STEP (PROTECTIVE FILM FORMING STEP)
TEMPERATURE REDUCING STEP
PROCESSING TIME

Fig. 12

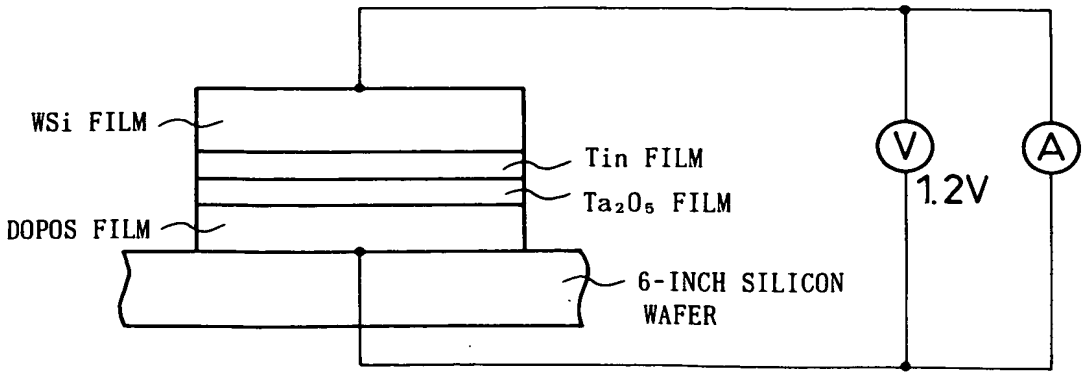

WSi FILM
DOPOS FILM
Tin FILM
Ta_2O_5 FILM
6-INCH SILICON WAFER
V
A
1.2V

Fig. 13

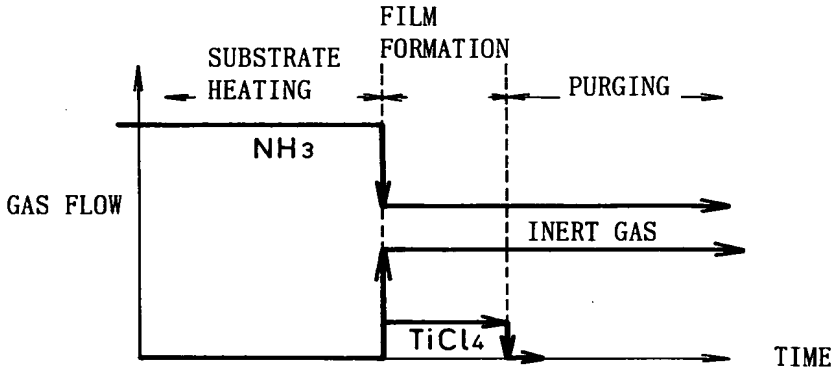

FILM
FORMATION
SUBSTRATE
HEATING
PURGING
NH3
GAS FLOW
INERT GAS
TiCl4
TIME

Fig. 14

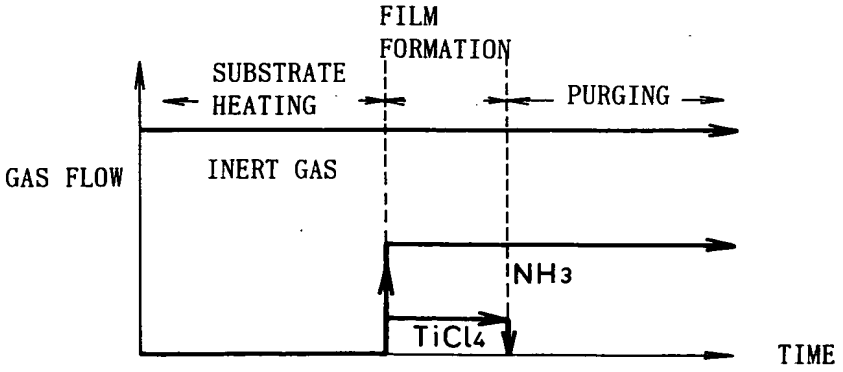

FILM
FORMATION
SUBSTRATE
HEATING
PURGING
GAS FLOW
INERT GAS
NH3
TiCl4
TIME

Fig. 15

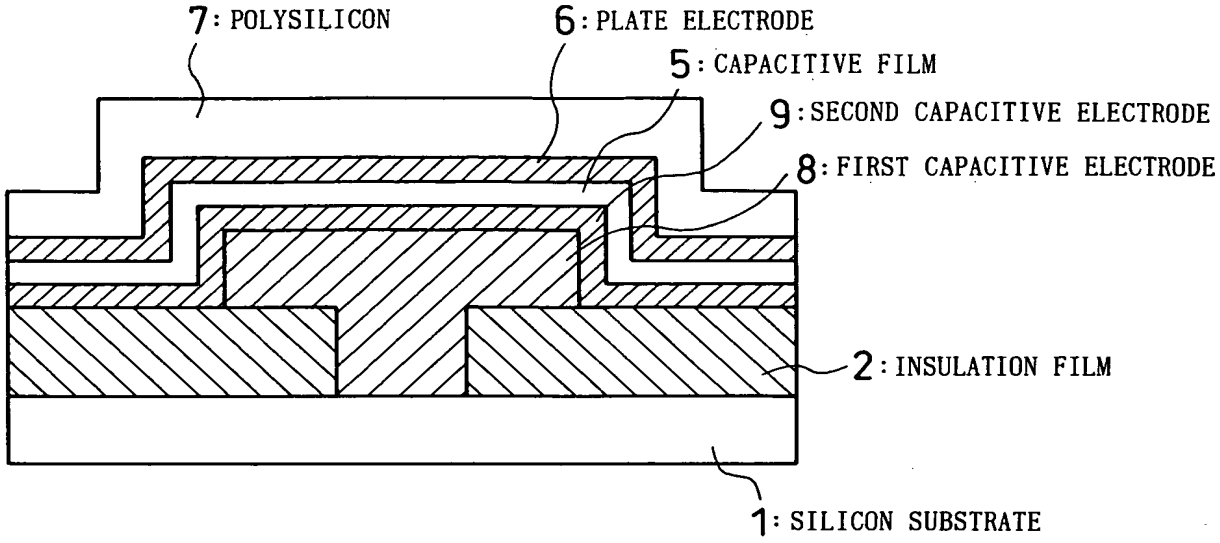

7: POLYSILICON
6: PLATE ELECTRODE
5: CAPACITIVE FILM
9: SECOND CAPACITIVE ELECTRODE
8: FIRST CAPACITIVE ELECTRODE
2: INSULATION FILM
1: SILICON SUBSTRATE

Fig. 16

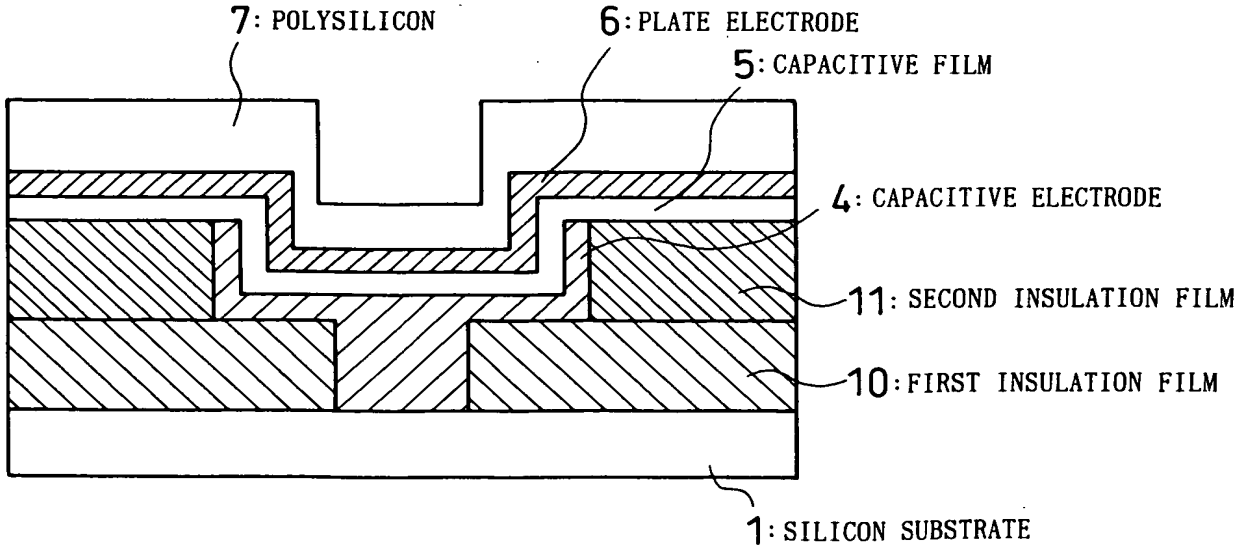

7: POLYSILICON
6: PLATE ELECTRODE
5: CAPACITIVE FILM
4: CAPACITIVE ELECTRODE
11: SECOND INSULATION FILM
10: FIRST INSULATION FILM
1: SILICON SUBSTRATE

TABLE 1

	Leakage current value 10^{-8}[A/cm²]			Tox [Å]
	Minimm value within surface	value over 50% of surface	Maximm value within surface	value over 50% of surface
Experimental example 1	2. 58	3. 39	17. 96	32. 74
Experimental example 2	2. 83	4. 17	20. 348	32. 97
Experimental example 3	4. 606	9. 98	23. 8	33. 25
Experimental example 4	5. 882	11. 2	25	33. 87

TABLE 2

	Leakage current value 10^{-8}[A/cm²]			Tox [Å]
	Minimm value within surface	value over 50% of surface	Maximm value within surface	value over 50% of surface
Prior art example	0. 074	0. 11	0. 194	34. 27
Experimental example 5	0. 032	0. 074	0. 128	34. 35

TABLE 3

	Leakage current value			Tox
	Minimm value within surface	value over 50% of surface	Maximm value within surface	value over 50% of surface
Experimental example 1	0.76	1	5.3	1
Experimental example 2	0.83	1.2	6.0	1.01
Experimental example 3	1.4	2.9	7.0	1.02
Experimental example 4	1.7	3.3	7.4	1.03

Note : For the leakage current values 3.39×10^{-8} A/cm² was taken as 1, and for Tox 32,74 Angstroms was taken as 1.

TABLE 4

	Leakage current value			Tox
	Minimm value within surface	value over 50% of surface	Maximm value within surface	value over 50% of surface
Prior art example	1.00	1.5	2.6	1.00
Experimental example 5	0.43	1	1.7	1

Note : For the leakage current values 0.074×10^{-8} A/cm² was taken as 1, and for Tox 33,35 Angstroms was taken as 1.